A NEW SPECIES OF *STREPTOCEPHALUS (PARASTREPTOCEPHALUS)* (CRUSTACEA: ANOSTRACA: STREPTOCEPHALIDAE) FROM NORTH QUEENSLAND, AUSTRALIA

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Streptocephalus (Parastreptocephalus) queenslandicus sp. nov. is described from temporary ponds near Atherton, north Queensland. It is related to four species of the recently erected subgenus *Parastreptocephalus* from Africa mainly because of male antennal morphology and the production of tetrahedral eggs, a unique feature within the family Streptocephalidae. This confirms the presence of *Streptocephalus* in Australia in a continent whose fairy shrimp fauna is dominated by *Branchinella* and *Parartemia.* ❐ *Parastreptocephalus, new species, Streptocephalus archeri, control in fish ponds, biogeography, fairy-shrimp.*

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Despite the early description by Sars (1896) of *Streptocephalus archeri* from the Rockhampton area of central Queensland, and a further collection of six females from the same area (Linder, 1941), no other specimens of the Streptocephalidae have been found in Australia. Adding to the enigma, the description was based entirely on females, so that it is difficult to determine the relationships of *S. archeri* within the genus. It is not surprising then that subsequent studies on *Streptocephalus* have reported little on *S. archeri* (see Brendonck et al., 1992; Belk & Brtek, 1995) and reviews of aquatic invertebrates in Australia have discounted the presence of *Streptocephalus* in Australia (Geddes, 1981, 1983; Williams, 1980, 1981).

Over the last few years fairy shrimps have been encountered by one of us (BH) each time aquaculture ponds were filled at the Freshwater Fisheries and Aquaculture Centre, Walkamin, on the Atherton Tablelands in north Queensland. Specimens collected in February 1997 were identified by BVT as a species of *Streptocephalus*. Further collections in October 1997 confirmed their presence and provided data on development times. The males are different to any known species of *Streptocephalus* and the females appear different from those of *S. archeri*, so they are described here as a new species.

CRUSTACEA
ANOSTRACA
STREPTOCEPHALIDAE Daday, 1910
Streptocephalus Baird, 1852
Parastreptocephalus Brendonck, Hamer & Thiery, 1992

Steptocephalus (Parastreptocephalus) queenslandicus sp. nov.
(Figs 1-3)

ETYMOLOGY. From Queensland, where the specimens were found. This complements names based on localities in Africa for many other species of the *Parastreptocephalus* (Brendonck et al, 1992).

MATERIAL. HOLOTYPE: ♂, QMW24520. PARATYPES: 9 ♂s, QMW24521; 10 ♀'s, QMW24522. Queensland Museum. Lengths: ♂ holotype and paratypes 12.1 ± 1.2mm; ♀ paratypes 12.1 ± 0.9mm. OTHER MATERIAL: 46 adults collected from rearing ponds at the. Walkamin Research Station, Walkamin, via Atherton, N Qld, Feb. 1997, B. Herbert, QMW24579 Queensland Museum. 100+ immature specimens from a subsequent filling of the same ponds collected by B. Herbert on 16 Oct. 1997, QMW24580, Queensland Museum.

TYPE LOCALITY. Fish rearing ponds, Walkamin Research Station, Walkamin, via Atherton, N Qld, 17°8'S, 145°26'E, altitude 590m a.s.l. Collector B. Herbert, Feb. 1997 2-3 weeks after flooding of ponds.

DESCRIPTION. *Male*. Antennules simple and long, almost reaching end of antennal base, tapering slowly towards a blunt tip which bears three setae (Fig. 1E). Lateral processes of antennae smooth, slightly curved backward and

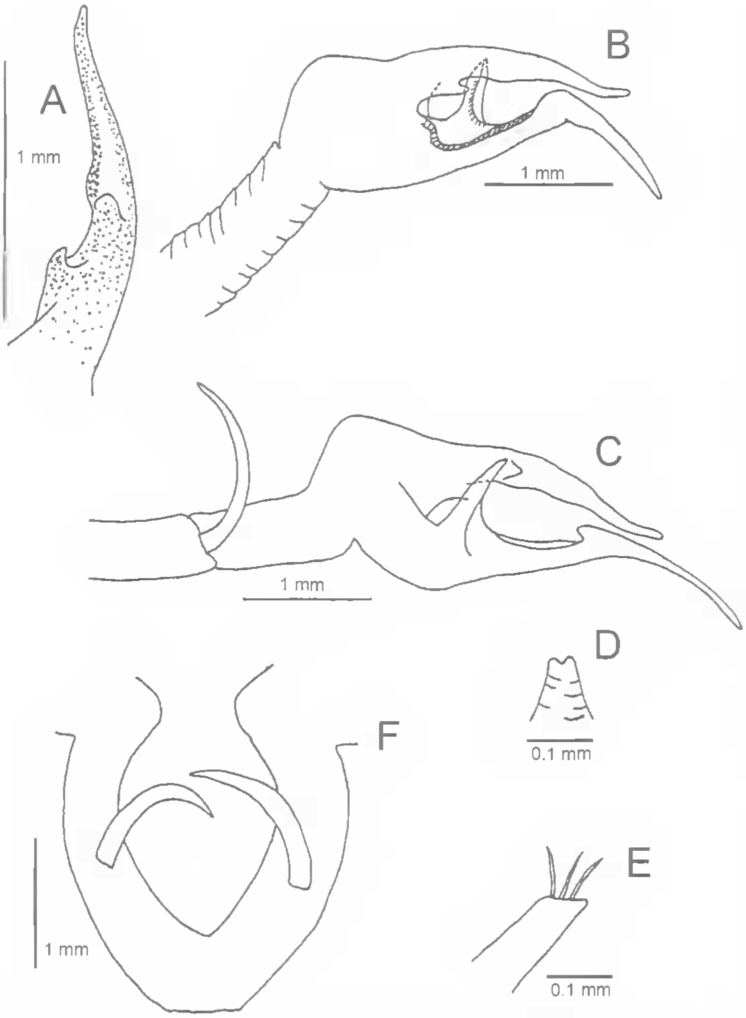

FIG. 1. *Streptocephalus (Parastreptocephalus) queenslandicu* sp. nov., ♂; A, dorsal view of finger of antenna; B, inner or medial view of right hand of antenna; C, lateral view of right hand of antenna; D, dorsal view of frontal organ; E, tip of antennule; F, base of antenna.

inserted at posteriobackward margin of distal end of basal segment (Fig. 1C,F). Median process of antenna continuing at same thickness of basal segment consisting of a short, slightly bent middle part and a terminal hand (Fig 1B,C). Basal part of hand about twice as wide as middle and whole hand about twice the length of the middle part. Much of the outside of the hand with a warty surface, as opposed to a smooth surface on the middle part and inner surface of the thumb and finger. Basal part of thumb grooved, with chitinised wavy edges (Fig 1B,C). The outer base carrying a curved pointed spur having one margin continuous with the chitinised wavy edge of the basal groove of the thumb (Fig. 1B,C). Distal half (anterior) of thumb attached at an obtuse angle (140-160°) and with a basal protuberance marking the end of the groove (Fig. 1B,C). Distal end of the thumb tapering to a slightly recurved point reaching well beyond the tip of the finger. Finger with two teeth, one on the inner margin and the other on the upper surface, so that the spur of the thumb extends near both (Fig. 1A-C). The upper marginal tooth recurved and with a blunt point, while the tooth on the inner surface is rounded (Fig. 1A). Distal to the rounded tooth is a smooth groove flanked on the inner margin with a warty protuberance near the tooth and a warty surface elsewhere (Fig. 1A). Apical part of tooth curved backward. Frontal appendage small with a double blunt point (Fig. 1D).

Thoracopods with five endites, decreasing markedly in size distally. Many long posterior setae, but with a restricted number of anterior setae, as itemised in Table 1 and shown in Fig. 2A-F. Endopodite broadly truncated with an apical shallow notch medially. External margin of endopodite with hook-like setae, but medially, especially towards the medial-distal corner setae longer, straighter and plumose (Fig. 2G,H). Base of endopodite setae with 2-8, usually 3-4, very small spines. Exopodite ladle-shaped and with numerous long plumose setae, but with a few small stout tooth-like setae at the base of the external margin (Fig. 2A,I,J). The long setae also attended at their base with very small spines, 2-6 in number but usually 3-4. Epipodite rather similar in shape to the exopodite, but smaller and without marginal setae. Preepipodite lamelliform and with irregular small hooks on the external margin (Fig. 2A,K).

First ten pairs of thoracopods similar except for two extra anterior setae on endite 5 of limb 1.

Occasionally there may be reductions in the number of long anterior setae of endites 3-5 of limbs 2-10. Eleventh pair of thoracopods reduced, mostly at the inner proximal corner, so that endites 1 and 2 much reduced, but other components only a little smaller and less setose than for thoracopods 1-10. Anterior setae on the endites of limb 11 much reduced and the number of posterior setae reduced. but still >10, on endites 1 and 2.

Basal and nonretractable parts of penes each bearing near its base a posteriorly curved median sausage-like outgrowth with 3-4 teeth on the proximal surface (Fig. 3A,B).

Cercopods (Fig. 3C) lanceolate and separately attached to posteriorlateral margin of a short telson. Each bears plumose setae on its inner and outer margins and the tip.

Female. Antennules filamentous, slightly longer than antennae or of equal length. Tip with three setae as in male. Antennae foliaceous and oval with broadly rounded margins and no apex (Fig. 3E). Slight notch sometimes on the mid-distal margin. Margins edged with small weak setae, with very few near the basal portion. Brood pouch cylindrical, elongate, extending to the end of the sixth abdominal segment in mature specimens, i.e. pouch is four segments long (Fig. 3D).

Immature eggs spherical, but mature shelled eggs tetrahedral (Fig. 3F). Corners somewhat rounded and hyaline; edges also hyaline and slightly thickened. Planar surfaces slightly convex and with a small raised area in the middle. Within the hyaline thickening on the edges and corners the embryo is round.

Thoracic appendages and cercopods as in male.

DIAGNOSIS. The present specimens easily lie within *Streptocephalus* because the antennae in the male have a medial outgrowth from the basal joint which terminates in a cheliform structure (Brendonck, 1990). Because of the tetrahedral eggs of the female and the well developed spur of the thumb and the lack of teeth between this spur and the anterior (main) part of the thumb, they lie within the subgenus *Parastreptocephalus* as presently defined (Brendonck et al., 1992).

Though the general structure of the antennae, thoracopods, cercopods and the nonretractable part of the penes of the male are very similar to those of the four species of *Streptocephalus* so far asssigned to *Parastreptocephalus* (Brendonck et al., 1992), none have the same antennae structure or setation of the endites of the thoracopods as in *S.(P). queenslandicus*. The teeth of the antennal finger are more rounded, spaced further apart and in different planes than in the other three species of *Parastreptocephalus* with teeth on the finger. The endite setae are very similar to those of *S.(P.) sudanicus* and *S.(P.) zuluensis*, the two species of *Parastreptocephalus* that have been studied in detail (Brendonck et al., 1992). The only consistent difference is the presence of three instead of four anterior setae on the first endite in *S. (P.) queenslandicus*.

TABLE 1. Idealised arrangement of setae on the 5 endites of male thoracopods of *S. queenslandicus*. First figure indicates number of anterior setae, second the number of posterior setae. m = many (> 10).

Thoracopod	Endite				
	1	2	3	4	5
1st pair	3 + m	2 + m	2 + 3	2 + 2	3 + 2
1st – 10th pair	3 + m	2 + m	2 + 3	2 + 2	1 + 2
11th pair	1 + m	1 + 3	2 + 2	2 + 1	1 + 1

Although *S. archeri* was incompletely described by Sars, there are a number of differences between it and *S. queenslandicus*. The medial distal part of the antenna has no short pointed projection in *S. queenslandicus* as it has in *S. archeri*. The brood pouch is four segments long in *S. queenslandicus* whereas it is only two in *S. archeri*. Part of this difference may be explained by the greater overall length of *S. queenslandicus* (12mm as against 9mm for *S. archeri*). The tetrahedral eggs of *S. archeri* 'exhibit plane or very slightly concave faces connected by obtuse, prominent ribs' (Sars, 1896), though the diagrams show them with markedly concave planar surfaces. By contrast the eggs of *S. queenslandicus* have slightly convex surfaces and the ribs (i.e. the edges of each tetrahedral surface) are not obtuse or particularly prominent. *S. archeri* eggs, while tetrahedral, are more like those of *S. sudanicus*, while those of *S. queenslandicus* are more like those of *S. zuluensis* particularly in the rib structure, though the planar surfaces are slightly convex in *S. queenslandicus* and slightly concave in *S. zuluensis* (see Brendonck et al., 1992). These apparent differences in egg structure may be artefacts of preparation and so of limited diagnostic value (L. Brendonck, pers. comm.).

The type localities are quite different for the two species. *S. archeri* apparently inhabits waterholes near sea level that become saline at very

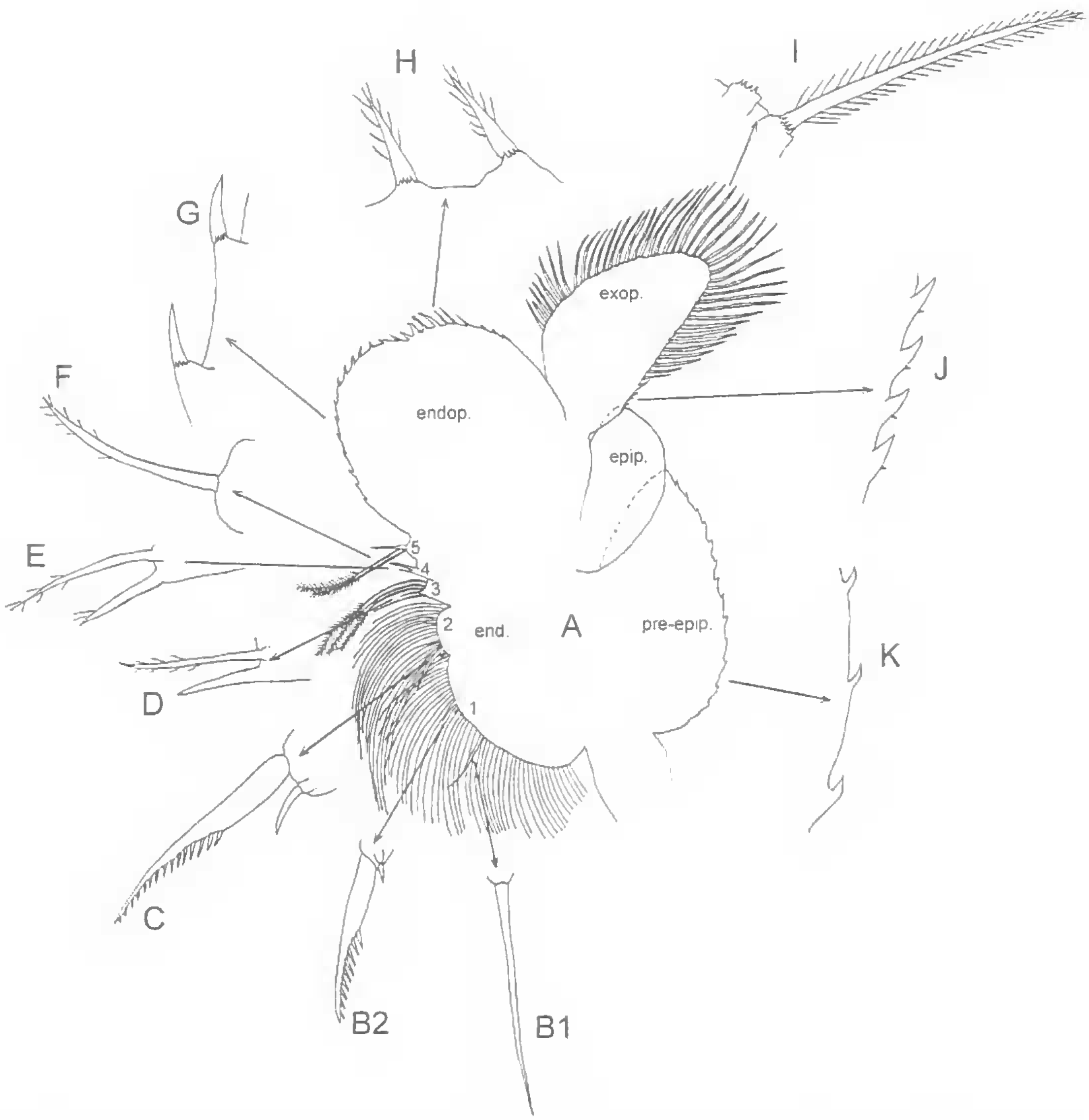

FIG. 2. *Streptocephalus (Parastreptocephalus) queenslandicus* sp. nov. ♂; A, 3rd right thoracic appendage; B1, detail of 1st anterior setae of first endite; B2, details of 2nd and 3rd anterior setae of 1st endite; C, details of anterior setae of 2nd endite; D, details of anterior setae of 3rd endite; E, details of the anterior setae of 4th endite; F, details of anterior setae of 5th endite; G, detail of hook-like setae on median margin of endopodite; H, detail of small plumose setae on distal margin of endopodite; I, detail of setae of exopodite; J, detail of hook-like setae on external margin of exopodite; K, detail of edge of preepidopodite. Abbreviations: end. = endite; endop. = endopodite; exop. = exopodite; pre-epip. = preepipodite.

high tides (though there is no suggestion that it lives in saline waters), while *S. queenslandicus* lives in fish hatchery ponds at 590m a.s.l. on the Atherton Tableland 860km NW of Rockhampton.

While the differences between the females of *S. archeri* and *S. queenslandicus* are small and of unknown reliability, the balance of probabilites suggest they are separate species. Only the rediscovery of *S. archeri* at or near its type locality and the recovery of males will provide the basis for a more convincing differential diagnosis.

ECOLOGY. Like most anostracans, *S. queenslandicus* has been observed to hatch soon (24 hours) after the filling of a pond and take 2-3 weeks to reach maturity. Hatching can occur in any season, with growth hardly affected by temperature which varies annually from 17-28°C. They generally persist in the ponds for about a month, with males dying much earlier than females. Only after the ponds are drained, dried and refilled do they reappear. It is possible that dispersal is only by resting eggs in mud, as so far newly constructed ponds using water from ponds infested with *S. queenslandicus* have not developed populations.

Shrimps feed on algae and do best when phytoplankton is abundant soon after hatching. They seem incapable of using either *Volvox* or *Anabaena* which often predominate in the hatchery ponds. Sometimes they die out before reaching maturity — this happened in the October 1997 hatching and seems to have been due to a large reduction in the algae in the pond caused either by their own feeding or by a large population of the cladoceran *Moina micrura*. In hatchery ponds *S. queenslandicus* is a serious competitor for the more desirable *M. micrura* and copepods. It is controlled by the use of hydrated lime at 40-50ppm applied 3-6 days after filling of the ponds.

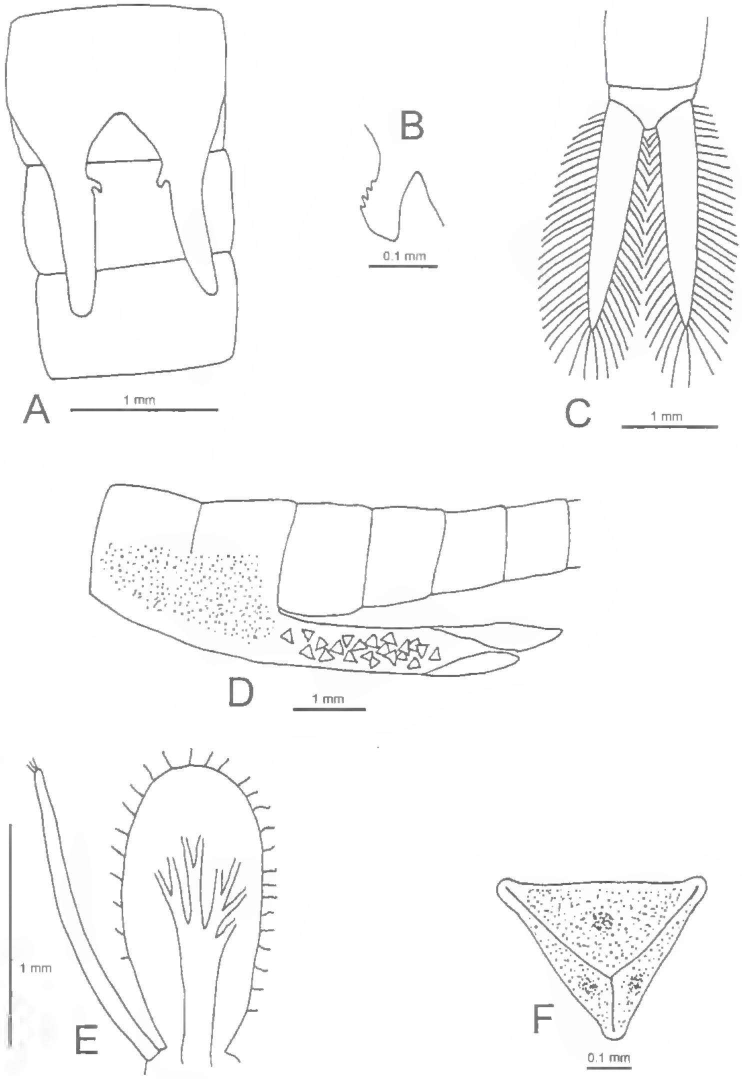

FIG. 3. *Streptocephalus (Parastreptocephalus) queenslandicus* sp. nov.; A, ventral view of ♂ genital region; B, detail of median process on basal part of penis; C, male telson; D, lateral view of ♀ abdomen with brood pouch; E, ♀ antenna; F, ♀, tetrahedral egg.

BIOGEOGRAPHY

The confirmed presence of *Streptocephalus* in Australia raises interesting biogeographical questions. This genus is represented in tropical and warm temperate areas of the Neoarctic, Palaeartic and especially the African biogeographic realms by about 50 species (Banarescu, 1990; Belk & Brtek, 1995), and now the Australian region has at least two species. Significantly both species occur in the tropics. However, while *Streptocephalus* is the dominant anostracan in Africa and *Branchinella* uncommon (Banarescu, 1990), in Australia the position is reversed. Geddes (1981, 1983) in his studies of Australian anostracans had numerous collections of *Branchinella* but none of *Streptocephalus*. There is no apparent reason for this difference, but perhaps *Streptocephalus* arrived later in Australia than *Branchinella* and is unable to successfully compete with a relatively large endemic fauna. In this context Banarescu (1990) believes that

Branchinella spread from a Gondwana base before *Streptocephalus*. Adding further evidence for the later arrival of the Streptocephalidae in Australia is the fact that all forms so far found belong to the subgenus *Parastreptocephalus* which seems to be a derived form of *Streptocephalus*. Or could it be that the tetrahedral eggs of this subgenus give it some advantage in competition against other species (Brendonck et al., 1992), so that only these forms, rather than *Streptocephalus* sensu strictus, have some chance in the competition against incumbent dominant *Branchinella*?

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